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A NEW TROGLOBITIC CRAYFISH (DECAPODA, CAMBARIDAE) FROM PENINSULAR FLORIDA

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Several previously undescribed species of troglobitic crayfishes have been reported recently from Florida. Hobbs (1971) described *Procambarus* (*Leconticambarus*) *milleri*, the first new form recorded since 1942 (when he reviewed the crayfishes of the state). At this time (1971), he summarized the known ranges, provided a key, and illustrated the diagnostic features of all of the troglobitic species known to occur in Florida. Since then, three additional crayfishes have been named: *Procambarus* (*O.*) *orcinus* Hobbs and Means (1972:394), *P.* (*O.*) *horsti* Hobbs and Means (1972: 401), and *P.* (*O.*) *erythrops* Relyea and Sutton (1975:8). Accompanying the description of the latter was a revised key to the troglobitic crayfishes of the state prepared by Hobbs. The species described here brings the total number of known Floridian troglobitic crayfishes to 11, all except two of which are members of the genus *Procambarus*.

We take pleasure in naming this crayfish in honor of Richard Franz, a colleague, friend, and outstanding student of cave ecosystems. His continued interest and support of this study are greatly appreciated.

We wish to thank Sylvia Scudder, Richard Bradley, Barbara Lee, and Richard Franz for their assistance in collecting the specimens on which the following description is based. We also wish to acknowledge the assistance of John E. Cooper who provided useful information leading to

Franz's initial location of Orange Lake Cave, the source of our specimens. For their critical reading of the manuscript, we are grateful to Thomas E. Bowman, Martha R. Cooper, and Margaret A. Daniel.

Procambarus (Ortmannicus) franzi, new species

Diagnosis: Albinistic, eyes without pigment or faceted cornea. Rostrum with, or more often without, marginal spines; median carina absent. Carapace with cervical spine cephaloventral to row of spines or tubercles flanking caudal margin of cervical groove. Areola 12.8 to 17.2 times as long as broad and constituting 38.7 to 41.0% of total length of carapace (47.1 to 49.5% of postorbital carapace length). Suborbital angle absent. Postorbital ridge with cephalic spine. Hepatic area with many small tubercles, some spiniform. Antennal scale approximately twice as long as wide, broadest slightly distal to midlength. Ischia of third and fourth pereiopods of first form male with simple hooks, that on third overreaching basioischial articulation and that on fourth highly arched, almost reaching basioischial articulation, and opposed by low eminence on basis; coxa of fourth pereiopod with prominent oblique boss. First pleopod of first form male reaching coxa of third pereiopod, asymmetrical, provided with subapical setae; distal extremity bearing subspiculiform mesial process directed caudally at approximately right angle to shaft of appendage and curved laterally; cephalic process rather short, acute, somewhat hooding central projection cephalically, and directed caudodistally; caudal element consisting of inconspicuous, caudolaterally situated caudal knob, and prominent, corneous adventitious process caudomesially, latter distally rounded, convex mesially, and somewhat concave laterally; and corneous beaklike central projection, most conspicuous of terminal elements, directed caudodistally subparallel to cephalic process. Annulus ventralis freely movable, subspindle-shaped, slightly more than twice as broad as long, and completely exposed, not (partly) hidden by projections from sternum immediately cephalic to it; cephalic area with convex elevated area bearing submedian J-shaped furrow; sinus originating in furrow and, following sinuous curve caudally, terminating to side of median line slightly caudal to midlength of annulus. Postannular plate slightly more than half as wide and half as long as annulus with cephalic region somewhat inflated. First pleopod in female moderately well-developed.

Holotypic Male, Form I: Cephalothorax (Fig. 1*a*, *l*) subcylindrical. Abdomen narrower than thorax (10.1 and 13.1 mm). Greatest width of carapace greater than height at caudodorsal margin of cervical groove. Areola 14.7 times as long as wide with 1 or 2 punctations across narrowest part. Cephalic section of carapace approximately 1.5 times as long as areola, length of latter 40.7% of entire length of

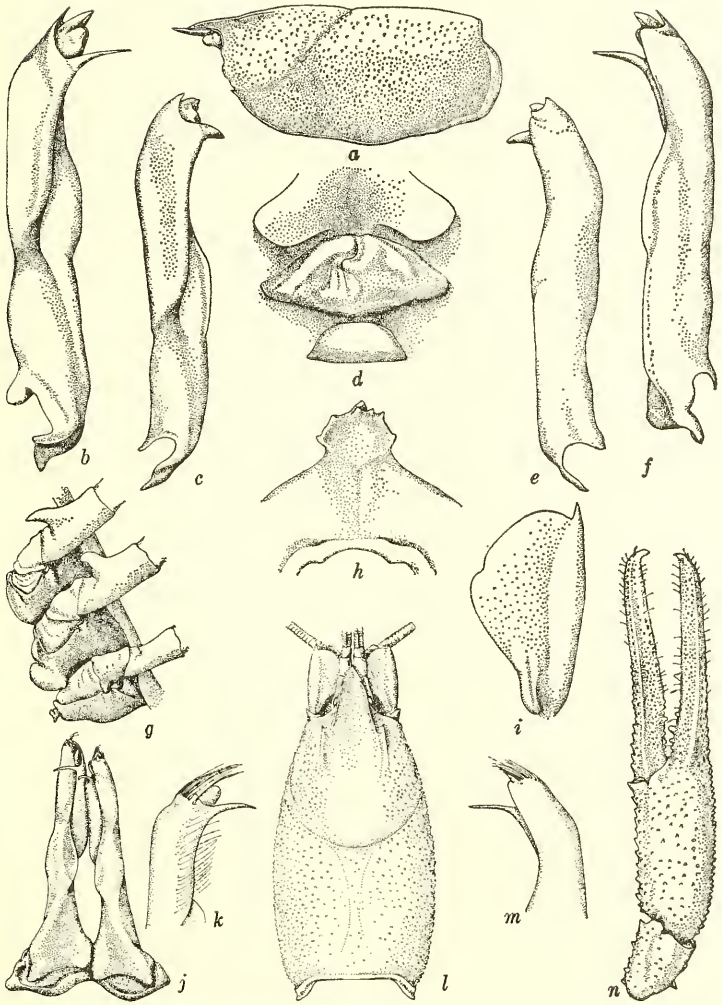

FIG. 1. *Procambarus* (*Ortmannicus*) *franzi*, new species (all illustrations are of holotype except *c* and *e* of morphotype, and *d* of allotype): *a*, Lateral view of carapace; *b*, *c*, Mesial view of first pleopod; *d*, Annulus ventralis; *e*, *f*, Lateral view of first pleopod; *g*, Basal podomeres of third, fourth, and fifth pereiopods; *h*, Epistome; *i*, Antennal scale; *j*, Caudosinistral view of first pleopods; *k*, *m*, Mesial view of terminal part of first pleopod showing subterminal setae; *l*, Dorsal view of carapace; *n*, Dorsal view of distal podomeres of cheliped.

carapace (47.9% of postorbital carapace length). Rostrum with gently convergent margins, lacking marginal spines or tubercles but with broad-based acumen clearly delimited by mesially curved cephalic ends of rostral margins. Acumen reaching midlength of penultimate segment of antennular peduncle; dorsal surface shallowly excavate and sparsely punctate. Subrostral ridge rather weak and evident in dorsal aspect along caudal three-fifths of rostrum. Postorbital ridges well-developed, grooved dorsolaterally, and terminating cephalically in small spine, more posterior spines lacking. Caudodorsal margin of cervical groove with row of spiniform tubercles, ventralmost member of row (cervical spine), larger than others. Suborbital angle virtually obsolete. Brachiostegal spine moderately strong. Entire dorsolateral and lateral surfaces of carapace studded with tubercles, some of them spiniform.

Abdomen only slightly longer than carapace (25.9 and 25.3 mm). Pleura of third through fifth abdominal segments truncate ventrally, those of fourth and fifth segments subangular caudoventrally. Cephalic section of telson with single fixed spine in caudodextral corner and 2 in caudosinistral corner. Cephalic lobe of epistome (Fig. 1*h*) subrhomboidal but asymmetrical with cephalomedian projection, 3 acute prominences on cephalosinistral margin, and 2 on cephalodextral; main body of epistome with shallow cephalomedian fovea continuous with caudally disposed submedian sulcus abutting epistomal zygoma. Ventral surface of proximal podomere of antennular peduncle with prominent submedian spine near midlength. Antenna with moderately large spine on basis and small spiniform tubercle on ischium; flagellum extending caudally beyond telson by at least length of latter. Antennal scale (Fig 1*i*) almost twice as long as broad, widest distal to midlength, and lamellar (part) about twice as wide as thickened lateral part.

Third maxilliped extending anteriorly to, or slightly beyond, level of tip of rostrum; ischium with distolateral extremity produced in acute prominence, and lateral half of ventral surface with scattered short setiferous punctations; exopod reaching distal end of carpus.

Right chela (Fig. 1*n*) subovate in cross section, not strongly depressed. Mesial surface of palm with several irregular rows of 10 or 11 strongly elevated tubercles; remainder of palm also tuberculate, more mesial tubercles stronger than more lateral ones on both dorsal and ventral surfaces. Both fingers with well defined submedian longitudinal ridge flanked proximally by tubercles and more distally by setiferous punctations. Opposable margin of fixed finger with row of 8 tubercles along proximal half of finger, third from base largest, and with single, large, more ventrally situated one slightly proximal to midlength; band of minute denticles extending almost from proximal end of finger (between and ventral to row of tubercles) to base of corneous tip, band distinctly broader distal to level of ventral tubercle. Lateral surface of fixed finger with tubercles, decreasing in size dis-

TABLE 1. Measurements (mm) of *Procambarus* (*Ortmannicus*) *franzi*.

	Holotype	Allotype	Morphotype
Carapace			
Height	10.2	11.1	10.0
Width	13.1	12.9	12.2
Total length	25.3	26.9	25.2
Postorbital length	21.5	22.1	20.9
Areola			
Width	0.7	0.7	0.8
Length	10.3	10.4	10.2
Rostrum			
Width	3.6	3.6	3.5
Length	5.2	5.9	5.6
Chela			
Length of mesial margin of palm	9.0	7.0	7.0
Width of palm	5.6	4.5	4.6
Length of lateral margin	25.1	21.8	20.2
Length of dactyl	14.7	13.4	11.7
Abdomen			
Width	10.1	10.2	9.8
Length	25.9	26.7	25.3

tally, along proximal half followed by row of setiferous punctations, latter reaching base of corneous tip of finger. Opposable margin of dactyl with row of 9 tubercles, fifth from base largest, along proximal third of finger; minute denticles between and dorsal to row of tubercles and forming broad band immediately distal to last tubercle of row, band continuing to base of corneous tip of finger. Mesial surface of dactyl similar to lateral surface of fixed finger with tubercles diminishing in size distally.

Carpus of cheliped longer than broad, tuberculate on all surfaces, conspicuously so mesially where 1 tubercle more prominent than others; additional strong tubercle present on dorsomesial distal angle. Shallow oblique sulcus on dorsal surface flanked by small subsquamous tubercles. Ventrodistal margin of podomere with 3 tubercles: weak lateral one, moderately strong one on articular knob, and prominent acute one mesially; row of 3 tubercles extending proximally from latter.

Merus of cheliped strongly tuberculate except for proximal parts of mesial and lateral surfaces. Dorsal surface with linear series of tubercles basally continuous with broadening band of them distally; tubercles on ventral surface abundant, not limited to usual 2 rows; rows poorly

defined but each consisting of 20 to 23 tubercles. Ischium with row of 6 tubercles ventromesially, distalmost slightly larger than proximal 5.

Hooks on ischia of third and fourth pereiopods (Fig. 1*g*) as described in "Diagnosis." Coxa of fourth pereiopod with prominent oblique (almost vertical), somewhat inflated caudomesial boss; that of fifth pereiopod with very weak prominence corresponding to caudomesial boss on fourth pereiopod.

Sternum between third and fourth pereiopods rather deep with conspicuous mat of plumose setae extending mesially from ventrolateral margins. First pleopods (Fig. 1*b*, *f*, *j*, *k*, *m*) as described in diagnosis; mesial process of left member not bent nearly so strongly laterally as that on right pleopod. Uropod with both lobes of basal podomere bearing spines; distomedian spine on mesial ramus far removed from distal margin of ramus.

Allotypic Female: Differing from holotype in following respects: rostrum with marginal spines and reaching proximal end of ultimate podomere of antennular peduncle; subrostral ridges evident in dorsal aspect only along basal fourth of rostrum; tubercles of spiniform row flanking caudal margin of cervical groove much less conspicuous and cervical spine smaller; cephalic section of telson with 2 spines in each caudolateral corner; cephalic lobe of epistome symmetrical with weak prominences at angles of rhomboid; opposable margin of fixed finger of chela with row of 9 tubercles, fourth from base largest, that of dactyl with row of 13 tubercles, fifth from base largest; ventromesial margin of ischium of cheliped with row of 7 tubercles.

Annulus ventralis (Fig. 1*d*) only moderately deeply situated in sternum (see "Diagnosis" for details). Sternum immediately cephalic to annulus lacking ornamentations. First pleopod reaching slightly cephalic to caudal margin of annulus when abdomen flexed (see "Measurements").

Morphotypic Male, Form II: Differing from holotype in following respects: rostrum with small marginal tubercle dextrally (sinistral margin as in holotype), and reaching almost midlength of ultimate podomere of antennular peduncle; subrostral ridges evident in dorsal aspect from caudal margin of orbit to acumen; postorbital ridge with well defined posterior tubercles, sinistral one almost serrate; cervical spine very small, hardly larger than adjacent tubercles; epistome similar to that of allotype but anterolateral angles less sharp, and weak prominences present closely flanking cephalomedian prominence; cephalic section of telson with single fixed spine in each caudolateral corner; lateral ramus of sinistral uropod deformed, possessing bilobed distal segment; opposable margin of fixed finger of chela with row of 6 tubercles, that of dactyl with 11; ventromesial surface of ischium of cheliped with row of 8 tubercles and few others nearby; hooks on ischia of third and fourth pereiopods much reduced, that on third not overreaching basioischial articulation; boss on coxa of fourth pereiopod also much reduced. First pleopod (Fig. 1*c*, *e*) without corneous ter-

minal elements; mesial and cephalic processes much shorter and heavier, caudal element much less sharply defined, and central projection shorter, and decidedly more tumescent (see "Measurements").

Type-locality: Orange Lake Cave, 0.4 mi S of junction of U.S. Hwy. 441 and State Route 318 off Hwy. 411 (T.12S, R.21E, Sec. 33/34), Marion County, Florida.

Orange Lake Cave is a small, horizontal cavern located on the north side of a quarry of several acres. The status of the entrance prior to quarrying operations is unknown. The two present openings (2 m × 1.5 m; 1.5 m × 3 m) lead into a small room. The main passage (approximately 1 m wide) leads north and northeast from about 20 m and terminates in a large, irregular room (15 m long, 5 m wide, and 3–7 m high) where the water level fluctuates markedly. On 8 September 1974, water was encountered within 5 m of the entrance, and the floor of the entire passage and that of the room in the back of the cave were inundated. On 18 May 1975 and 19 November 1975, the water was about a meter lower and was confined to the rear of the big room. On other visits (5 January 1975, 28 September 1974, etc.) water levels were intermediate between these extremes. Water temperature remained at 21–22° C throughout the collecting period.

In the spring, as many as 3700 bats (*Myotis austroriparius*) use the back room of this cave as a maternity site. Throughout the remainder of the year, the bats are not usually present, but Richard Franz reported 6000 individuals having been found there on 19 November 1975. The bats are probably responsible for the major source of energy for the Orange Lake Cave crayfish population. Nearly all of the crayfish were observed in the pool directly under the bat roosts. The total number of crayfish counted on 18 May 1975 and 19 November 1975, when they were confined to one pool, was 32 and 23, respectively. A large percentage of the population consisted of juveniles.

On two occasions (October 1974 and 5 January 1975), several small, white crayfish, assumed to be a part of this same population, were seen in a small solution cavity in the floor of the quarry. The water level was about 1.5 m below the bottom of the quarry. Other openings in the sides and bottom of this same quarry apparently do not contain water.

Disposition of Types: The holotype, allotype, and morphotype are deposited in the National Museum of Natural History (Smithsonian Institution), numbers 146992, 146993 and 146994, respectively, as are the paratypes consisting of 1 ♂ II, 5 ♀, and partly decayed remains of 1 ♂ I.

Size: The largest of the specimens is a female having a carapace length of 29.0 mm (postorbital carapace length 23.5 mm). Perhaps the (partly) decayed form I male was a little larger. The only other first form male is the holotype possessing corresponding lengths of 25.3 and 21.5 mm.

Range and Specimens Examined: This crayfish is known only from

the type-locality, and the only specimens available are those included in the type-series: 1 ♂ I, 8 September 1974, R. Franz and D. S. Lee, coll.; 1 ♂ II, 2 ♀, 1 October 1974, R. F. and D. S. L., coll.; 3 ♀, 19 May 1975, B. Lee and D. S. L.; 1 ♂ I, 1 ♀, 19 November 1975, R. F., R. Bradley, and S. Scudder, coll.; 1 ♂ II, 8 December 1975, R. F. coll.

Variations: The most conspicuous variation observed is in the rostrum. Except in a few specimens in which there are marginal spines present and in the morphotype in which such a spine is present on one side, all of the other specimens lack marginal spines. Instead the rostral margins curve mesially at the base of the acumen, merging with the flattened dorsal surface of the latter. The subrostral ridges which are continuous with the margin of the acumen may be visible along the length of the rostrum from the level of the caudal margin of the orbit to the tip of the acumen, or the rostral margins may obscure, in dorsal view, part of them between the orbit and the base of the acumen. The other slight variations noted are in the number, disposition, and sizes of the tubercles, both on the carapace and on the chelipeds, but only those differences occurring on the postorbital ridges seem worthy of mention. Even in a single individual, the tubercles on the paired ridges are not identical; one ridge may have an arrangement of tubercles that might be described as almost serrate while the tubercles on the other are so reduced as to be easily overlooked. The only consistency is the presence of a small apical tubercle.

Relationships: *Procambarus* (*Ortmannicus*) *franzi* is the seventh troglobitic member of the subgenus to be described, all of them from the subterranean waters of Florida, and all at least as closely related to one another as to any epigean crayfish. Three of the previously described species, *P.* (*O.*) *pallidus* (Hobbs, 1940:394), *P.* (*O.*) *horsti* and *P.* (*O.*) *orcinus* share in common a somewhat laterally displaced cephalic process on the constricted distal part of the first pleopod of the male, and the sternum immediately cephalic to the annulus ventralis in the female is produced into caudally projecting prominences that are not present in the remaining ones: *P.* (*O.*) *lucifugus lucifugus* (Hobbs, 1940:398), *P.* (*O.*) *l. alachua* (Hobbs, 1940:402), *P.* (*O.*) *erythrops*, and the species described here.

The range of *P.* (*O.*) *franzi* to the south and east of *P.* (*O.*) *l. alachua*, with which it seems to share more features than with the other species, tends to support an assumption of close kinship. Specimens that have been identified as intergrades between the two subspecies of *P.* (*O.*) *lucifugus* were obtained from several caves approximately 20 mi S of Orange Lake Cave (see Warren, 1961:7).

The characters cited above distinguish it from *P.* (*O.*) *pallidus*, *P.* (*O.*) *horsti*, and *P.* (*O.*) *orcinus*, and the absence of pigment in the eye serves readily to separate it from *P.* (*O.*) *l. alachua* and *P.* (*O.*) *erythrops*. The tapering rostrum distinguishes it from *P.* (*O.*) *l. lucifugus*, and the terminal part of the first pleopod of the male is unique.

Common Name: Because this crayfish appears to have such a limited

range, the possibility of its ultimately being placed on the list of endangered species is very real. Inasmuch as a common name will become mandatory when its status of probable safety is considered, we propose that it be known as the Orange Lake Cave Crayfish.

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